The Case for Foreign Exchange Intervention: The Government as an Active Reserve Manager

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Abstract: This paper argues that major governments should actively manage their foreign exchange portfolios to maximize the risk-adjusted return to the taxpayer by exploiting long-term, fundamental based predictability in floating exchange rates. Such transactions—equivalent to foreign exchange intervention—would improve welfare by transferring risk from private agents to the risk-tolerant government. Interventions explicitly designed to profit the reserve management authority would be more likely to be successful and, to the extent that they are, would reduce resource misallocation.

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This paper argues that government authorities should hold and actively manage their foreign exchange portfolios to maximize their value. That is, government authorities should act as long-term, risk-tolerant investors, buying foreign exchange assets that have relatively high expected returns and selling those that have low expected returns. Such active reserve management would be equivalent to systematic foreign exchange intervention—transactions designed to influence the level or volatility of the exchange rate.[1] A successful policy of reserve management would improve welfare by generating profits to replace distortionary taxation. At the same time, intervention is likely to improve the distribution of risk because limits-to-arbitrage problems probably prevent the initial distribution of risk from being optimal.

The proposed sterilized reserve management strategy differs significantly from the current practice of major countries that have increasingly eschewed foreign exchange intervention in the last decade. The U.S. authorities, for example, have intervened only twice since August 15, 1995. Similarly, both the Bundesbank and the Swiss National Bank ceased intervening entirely in 1995 while the Reserve Bank of New Zealand did not intervene from March 1985 through September 2004.[2] The European Central Bank has been reluctant to intervene, though it did do so several times in late 2000. Even the Reserve Bank of Australia and the Bank of Japan, traditionally frequent market participants, have intervened less frequently in the last decade.

The proposed approach is similar, however, to aspects of the intervention strategies followed for many years in the post Bretton-Woods era by major central banks, which have

[1] Reserve management—a good risk/return/liquidity tradeoff—is usually distinguished from intervention, which is transactions designed to influence the exchange rate. In this paper, however, the two will be considered almost synonymous as the proposed reserve management transactions are also designed to influence the exchange rate.

[2] See Deputy Governor Sherwin's May 9, 2000, address to the World Bank Treasury at <http://www.rbnz.govt.nz/speeches/0092115.html> and additional information on recent intervention policy at <http://www.rbnz.govt.nz/foreignreserves/intervention/index.html>.

tended to buy (sell) their currencies when their expected return is high (low). The Reserve Bank of Australia has pursued a variant of this strategy for some time (Becker and Sinclair (2004)). And recently, the Reserve Bank of New Zealand explicitly adopted a similar intervention policy. Indeed, the policy is related to Friedman's (1953) observation that stabilizing speculation is equivalent to profitable speculation.

The proposed strategy does not entail intervening to defend the exchange rate at some fixed level. Such mechanisms are highly vulnerable to speculation, as shown by the Asian crisis of 1997, the Mexican peso crisis of 1994 and the European Monetary System crises of 1992-93. Neither does the strategy entail "leaning against the wind," countering short term fluctuations in the exchange rate. Rather, the strategy exploits reversion to long-term fundamental values that produces predictable long-term excess returns.[3] The strategy is appropriate only for nations with well developed financial markets and a history of stable macroeconomic policy.

This paper first examines how exchange rates deviate from simple versions of the efficient markets hypothesis and how official intervention can profit from such deviations. The proposed active reserve management strategy, its benefits and its success criterion, are then outlined. The paper then briefly discusses the evidence on the efficacy of central bank intervention and why the conventional wisdom on that efficacy is not very relevant to the proposed intervention strategy. Finally, arguments against intervention are considered before conclusions are drawn.

How does the foreign exchange market function?

The traditional foundation for understanding asset prices is the efficient markets hypothesis (EMH). The EMH holds that exchange rates reflect information to the point where

[3] The use of the phrase "long-term fundamentals" does not imply that the exchange rate is disequilibrated in the short-term.

the potential excess returns do not exceed the transactions costs of acting (trading) on that information (Jensen, 1978). The EMH, coupled with risk-neutrality, implies uncovered interest parity (UIP): Exchange rates changes should be predicted only by interest differentials. Unfortunately, exchange rates have baffled economists since the advent of floating rates in the early 1970s by deviating from simple models in at least three areas.

First, exchange rates do not covary with interest rate differentials in any explicable way in the short- and medium-term. That is, not only does uncovered interest parity fail to describe floating rate behavior, but no widely accepted model of a risk premium can explain the failure. Hodrick (1987) and Engel (1996) review the evidence on this *forward discount* puzzle, while Meredith and Chinn (1998) look at it for long-term rates.

Second, the large literature on successful trend-following technical trading rules in foreign exchange markets casts further doubt on simple versions of the efficient markets hypothesis (e.g., Sweeney (1986), Neely, Weller and Dittmar (1997)). These rules are extrapolative, meaning that they tend to buy assets that have had high recent returns. Many researchers have proposed that official intervention in foreign exchange markets might explain such profitability, but the evidence does not support this hypothesis (LeBaron (1999), Neely (2002) and Sapp (2004)). The lack of fundamental predictability at short horizons, combined with the predictability of risk-adjusted excess returns with technical rules, constitutes a real puzzle for international economists.

Third, foreign exchange rates are only weakly connected to fundamentals over longer horizons. Despite the fact that researchers have been looking assiduously for such links since the seminal work of Meese and Rogoff (1983), the relationship appears feeble, at best. Neely and Sarno (2002) review the weak evidence for predictability found by Kilian (1999), Mark and Sul

(2001) and Rapach and Wohar (2003) using monetary and purchasing power parity (PPP) fundamentals. Engel (2000), for example, questions whether PPP holds, even in the long-run.

Figure 1 illustrates the weak long-run predictability implied by an econometric model. The figure shows monetary model vector error correction model (VECM) forecasts of the change in the ITL/USD from Rapach and Wohar (2003). The VECM used exchange rates, money, and output data from 14 industrialized countries, over a span as long as 115 years (1880-1995). Despite the fact that this exchange rate maximizes the monetary model's out-of-sample fit among all exchange rates studied, the model explains little of the variation in the one-year ahead change. The top panel shows exchange rate changes and recursive, out-of-sample, forecasts from 1939 to the end of the sample in 1995. The bottom panel shows the same data from the beginning of the floating exchange rate era, 1973-1995. The monetary model appears to forecast best in extreme circumstances, such as the high inflation that Italy suffered during World War II or during 1986-1987, when the dollar weakened again after a period of unusual strength. In almost all periods, however, the monetary model explains very little of the variation in one-year ahead exchange rate changes.

A reasonable interpretation of the evidence is that exchange rates are connected to fundamentals in the long-run and/or under extreme conditions, but that exchange rates can deviate substantially from their fundamental values for significant periods.

Why do exchange rates fail to conform to economists' models?

The reasons for such deviations from a simple efficient markets model are not well understood. The stationarity/ergodicity of the data and the properties of statistical tests are always open to question, but it is hard to believe that econometric tests should have extraordinarily poor properties over such a variety of hypotheses.

A variety of reasons—entirely consistent with rationality—have been put forward to explain the persistent deviation of exchange rates from fundamentals: risk aversion, principal-agent problems, learning and information problems. Lewis (1989) and Klein and Lewis (1993) explore how learning can affect exchange rates. Shleifer and Vishny (1997) explored how traders are constrained by risk and principal-agent problems.

The market microstructure literature has emphasized the important roles of asymmetric information, opacity and sequentiality of trading, and heterogeneity in foreign exchange markets (Ito, Lyons and Melvin (1997)). Market participants observe quoted prices (but not transactions) to infer information from other agents' trades (Treynor and Ferguson (1985), Brown and Jennings (1989), Banerjee (1992), and Kirman (1993)). Such activities can produce information cascades or bubbles as less informed agents infer information about fundamental demand from past trades. These bubbles (or trends) are then reinforced by extrapolative trading rules.

The literature on behavioral finance provides another category of explanations. This literature finds that (1) experimental participants seem unusually optimistic about their chances for success in games and (2) the behavior and opinions of members of a group tend to reinforce common ideas or beliefs. Shiller (1989) and Shleifer and Summers (1990) discuss the field in more detail.

Either bounded rationality or behaviorally based departures from rationality might generate the volatile expectations that many researchers have blamed for the failure of exchange rate models. For example, Frankel (1996) argues that exchange rates are detached from fundamentals by swings in expectations about future values of the exchange rate. Four pieces of evidence suggest that overly volatile expectations are to blame for such behavior: 1) Survey measures of exchange rate expectations are very poor forecasts and are often not internally

consistent (Frankel and Froot, 1987, Sarno and Taylor 2001); 2) UIP's failure seems to hinge on irrational expectations (Engel, 1996); 3) Trend-following trading rules make risk-adjusted excess returns (Neely, 1997; Neely, Weller, and Dittmar, 1997); 4) Switching from a fixed to a floating exchange rate changes the volatility of real exchange rates and the ability of UIP to explain exchange rate changes (Mussa, 1986).

This latter point requires some explanation. Fixed exchange rates anchor investor sentiment about the future value of a currency. If expectations are based on fundamentals, then the relationship between fundamentals and exchange rates should be the same under a fixed exchange rate regime as it is under a floating regime. This is not the case. Real exchange rate volatility rises dramatically when countries switch from fixed to floating exchange rates, which sets expectations adrift (Mussa, 1986). Figure 2 illustrates a typical example: When the German government ceased to fix the DEM to the USD in March 1973, the variability in the real DEM/USD exchange rate increased considerably.

This suggests that swings in investor expectations may detach exchange rates from fundamental values in the short run. Similarly, while UIP does a poor job explaining USD exchange rates, it works fairly well with target zone rates such as those found in the EMS (Flood and Rose, 1996).[4] Indeed, Flood and Rose (1999) develop a UIP-based model of the exchange rate that explains why UIP—and exchange rate forecasts—might perform poorly in the short term, even with rational agents.

What are the consequences of such deviations?

To the extent that deviations from fundamentals are the result of learning or irrationality, they can lead to a potentially very costly misallocation of resources. When international

[4] Exchange regimes termed "fixed" usually involved target zones of some sort. The EMS was a system of fairly wide (2.25 or 6 percent) target zones. The earlier Bretton-Woods system involved target zones of ± 1 percent.

investors consider where to build a factory, an arbitrary exchange rate can lead to a productively inefficient outcome. Hysteresis in trade provides another channel by which temporary exchange rate misalignments could do permanent harm. Generally, the uncertainty associated with large exchange rate fluctuations does impose costs on the economy.

Even if the deviations result from risk aversion that is rational to an individual, they still affect resource allocation and scope exists for a Pareto improvement. For example, it might be completely rational for a bank to restrict its exposure to unhedged exchange rate fluctuations. But utility could be increased if it were able to take on more exposure and trade it to a less risk averse (or a better diversified) agent.

Equilibrium Models of the Foreign Exchange Market

Some would contend that describing exchange rates as being detached from fundamentals is nonsensical. In the 1980s this school of thought argued that real shocks drive changes in the equilibrium real exchange rate and much of the adjustment is done by nominal exchange rates (e.g., Stockman (1987)). This approach emphasized the exchange rate as an endogenous variable always adjusting to maintain equilibrium. While presenting some useful insights, the early versions of these models could not reconcile the very strong comovement of nominal and real exchange rates.

More recent research along these lines has sought to create general equilibrium models in which exchange rates seem to be disconnected from fundamentals, Duarte and Stockman (2002). Such models are not yet wholly convincing; they cannot explain the behavior of risk premia or variation in exchange rates. Models containing features such as noise trading and/or limits to arbitrage are also widely used (e.g., Devereux and Engel (2002), Duarte and Stockman (2001)).

The weaknesses of equilibrium models of the exchange rate highlight a serious difficulty in making the case for active reserve management. To assess the welfare consequences of a given reserve management policy, one would like to create a general equilibrium model of the economy, based on microfoundations, that accurately reflects our best understanding of how the economy functions. Unfortunately, predictive models of the exchange rate have failed and the leading explanations for how the foreign exchange market works (e.g., limited arbitrage, volatile expectations) have proven difficult to model in general equilibrium. Instead, this paper will informally assess the likely results of the proposed intervention policy in light of features that seem to describe how the real world operates.

Predictable excess returns and central bank intervention

The deviations from monetary fundamentals illustrated in Figure 1 appear to provide predictable long-term returns. How could volatile expectations and positive expected returns exist in the presence of countervailing speculation from rational speculators? Shleifer and Vishny (1997) point out that speculation on long-term reversion to fundamentals requires significant exposure to bankruptcy through margin calls or position limits. This sort of risk might limit private agents' speculation on long-term reversion to fundamentals.

Monetary authorities have been one source of long-term speculation on a return to fundamentals. And such intervention has been very profitable. U.S. authorities, for example, have made excess returns–returns on a zero investment strategy–on their foreign exchange intervention by "buying-low and selling-high" (Leahy (1995), Neely (1998)), though proper risk adjustment remains an issue (Sweeney (1997), Sjoo and Sweeney (2001)). These predictable

long-term returns, which are associated with deviations from PPP fundamentals, accompany the weak econometric predictability shown in Figure 1.[5]

Figure 3 shows DEM/USD and JPY/USD rates over the Bretton-Woods era and the purchasing power parity (PPP) implied values of those exchange rates.[6] Visual inspection of the figures indicates that the U.S. authorities have tended to purchase (sell) USD when the USD is undervalued (overvalued) compared to PPP. Formal statistical analysis, such as that performed in Neely (2002), confirm this casual impression.

By buying low and selling high, U.S. intervention has made significant excess profits—in excess of borrowing costs—on intervention. Figure 4 shows cumulative excess profits on U.S. intervention in the DEM (first panel) and JPY (third panel), as well as cumulative intervention in the respective currencies (second and fourth panels). The figure shows that, since the early 1980s, cumulative excess profits have increased most of the time. Neither are these results peculiar to U.S. intervention activities, they are typical of results achieved by most major central banks in USD markets. For example, Fischer (2003) shows that Swiss National Bank interventions have been profitable. Andrew and Broadbent (1994) and Becker and Sinclair (2004) do likewise for Australian interventions.[7] The third panels of Figure 5 through Figure 7 show that Swiss, Australian and Japanese intervention have been very profitable. In addition, one should note that each of these samples is over a different time period. The U.S. data extend from 1973 to 2004; the Swiss intervention data from 1986-1995; the Australian data from 1983 to 2000; and the Japanese intervention from 1991-2004. Yet the authorities have clearly made excess returns—over borrowing costs—in all these samples.

[5] Monetary and PPP fundamentals are not identical, but they are highly correlated in practice.
[6] DEM/USD rates after the introduction of the euro in 1999 are imputed from EUR/USD rates.
[7] Japan has been an exception to this strategy. Their USD transactions have overwhelmingly been USD purchases since 1991.

How should the authority intervene to manage reserves?

While one might assume that a government is very risk-tolerant for transactions the size of past intervention operations, even a government is not risk-neutral in the limit. Budget constraints eventually will bind. Given a modest degree of risk-tolerance, the reserve management agency should have a zone of inaction (or minimal intervention for those who dislike corner solutions) around a value of major real exchange rates that are consistent with historical values. As the exchange rate deviates from this zone, the reserve management authority trades, increasing its position in the currency that has a positive expected return, conditional on a return to fundamentals. The magnitude of intervention varies positively with the deviation.

The form and objectives of the reserve management strategy should be transparent—i.e., public information—to avoid confusion. Depending on the exact form of the intervention rule, it is possible that the reserve management authority could commit to its investment strategy by a suitable purchase of options.

Why do central banks inform the public of their views on fundamentals in such a circuitous way? Communicating policy goals and methods to the public is no easy task. The Federal Reserve, for example, has had considerable difficulties conveying its expectations on the likely future course of monetary policy actions in its FOMC directives. By committing money to intervention, the reserve management authority endorses its views in a way that makes it embarrassing to be wrong. Some would point out that the amount of money at stake in interventions is trivial compared to the government budget.[8] But that misses the point. Losing

[8] Intervention amounts are not trivial for all countries, but—historically—they are small for the United States. The Federal Reserve returned about $25 billion to the U.S. Treasury in 2005, which is about 0.2 percent of GDP. The largest net U.S. foreign exchange position--as a % of US GDP--was a $22b short position in the DEM in 1978, about 1% of U.S. GDP. If ones assumes that a large negative move might cost a foreign exchange position 25% of

money is embarrassing to public servants who take seriously their obligation to protect taxpayer resources.

Should the reserve management be conducted by the monetary authority or by another agency? Many monetary authorities would seek to keep control of intervention to keep in close contact with financial market conditions. This would also facilitate the day-to-day coordination of the reserve management and monetary policy operations. The negative of such a strategy is that collocating reserve management and monetary policy operations would increase the risk that the objective of the rule and the information content of the trades would be misinterpreted. On the other hand, an independent agency with the exclusive authority to intervene would avoid confusion between intervention goals and monetary policy.

The reserve management authority could be made operationally independent but accountable to the executive or legislature for following the prescribed reserve management rule, or explaining why it did not. The accountability rules for inflation targeting central banks could provide a template for such agreements.

The reserve portfolio position size will vary with the size of the domestic economy, the transaction volume in the market, and the risk tolerance of the authority. Governments whose reputations could be easily damaged by selling their own currency should probably forego active reserve management entirely.

The details of a fully articulated trading rule would depend on the authority's loss function, but the reaction function or the size of the position is secondary to the policy itself. After the government's loss function is established, the precise form of the portfolio management strategy could be devised.

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its value over a year, the largest amount at risk for the U.S. in the post Bretton Woods period was about 0.25% of GDP. Of course, if one thinks the exposure is too big—by whatever metric—then one can restrict the size of the intervening authority's position. The author thanks Guy Debelle for bringing this issue to his attention.

The proposed reserve management rule is similar to the intervention strategy recently proposed for the Reserve Bank of New Zealand and that apparently used by the Reserve Bank of Australia. It is more distantly related to the target zone proposals of Williamson (1987, 2002) and Edison, Miller and Williamson (1987) and has, at its core, the insight of Friedman (1953) that—under some assumptions—stabilizing speculation is equivalent to profitable speculation.[9] Friedman (1953) showed that destabilizing speculation is doomed to lose money and so drive the speculators out of the market. Friedman argued that speculation can only destabilize asset prices if the speculators consistently buy when the asset price is above its equilibrium value (driving the price up further) and sell when the asset price is below its equilibrium value; as the destabilizing speculators lose their money, he maintained, they will have less effect on the market. The corollary to this argument is that all successful speculation is stabilizing.[10]

Benefits of the strategy and the success criterion

There are three potential benefits to actively managing reserves in anticipation of a return of exchange rates to long-run fundamentals: 1) Intervention profits could substitute for distortionary taxation; 2) Intervention could reduce misalignments and resource misallocation; 3) Intervention could improve the ex ante distribution of risk.

The first of these benefits is straightforward to understand. If there are long-term predictable returns in foreign exchange markets, reserve management authorities can exploit them to generate zero investment returns for the taxpayer, substituting for distortionary taxation.

[9] Paul Volcker and Ronald McKinnon also have advocated target zones.

[10] Counterexamples to Friedman's (1953) argument have been found. For instance, Delong, Schleifer, Summers, and Waldman (1990) constructed a "noise trader" model in which irrational traders create so much risk in particular asset markets that the returns to those assets would have to be unusually high for rational traders to trade in them at all. The irrational traders make unusually high average returns by foolishly pursuing risky strategies. Some noise traders go out of business, but others prosper and this group maintains its market position.

As will be argued in the next section, intervention might not significantly reduce misalignments. However, if the intervention rule makes excess returns, then it is more likely that private agents will seek to emulate the reserve management authority's success with their own portfolio strategy. That is, as the market observes profitable intervention, private agents will trade with the reserve management authority, increasing the demand for the currency with the positive expected long-term return, making it more likely that misalignments will be reduced.

The reserve management authority's excess profits do not simply reflect a lump sum transfer of wealth from private agents to the government, however. Rather, it seems very likely that some combination of three features of the exchange market generate predictable excess returns: 1) systematic risk coupled with rational agents; 2) limits-to-arbitrage problems; and 3) volatile (possibly boundedly rational) expectations. The welfare consequences of intervention will depend on the importance of these features for exchange rate returns.

An accurate general equilibrium model of the economy could allow us to assess the welfare consequences of a given reserve management policy. The failure of standard predictive models of the exchange rate and the difficulty of modeling realistic features (e.g., limited arbitrage, volatile expectations) of the foreign exchange market, however, make such a model overly ambitious. Evaluating the effects of intervention policies in a partial equilibrium, limits-to-arbitrage model is a more achievable goal. Such research is ongoing. Rather than formally modeling the distribution of risk in an unrealistic model, this paper will informally assess the likely results of the proposed intervention policy in light of features that seem to describe how the real world operates.

If positive excess expected returns are due to systematic risk, then it is difficult to see

how intervention could improve the distribution of risk in a representative agent economy.[11] After all, the returns to the government's portfolio are those of the agent. Agents choose asset positions to maximize their utility, optimizing the risk-return tradeoff, given prices. For any intervention strategy (government portfolio choice), private agents would presumably alter the composition of their own portfolios to maintain their desired risk-return tradeoff (in which they include their share of the government's portfolio). While intervention will have no effect in this case, neither will it do any harm.

It is not difficult, however, to think of market imperfections—which could be described generically as risk—which prevent an optimal distribution of risk in the absence of intervention. It seems very likely that these imperfections—e.g., imperfect information, limited liquidity, principle-agent problems, and performance-based-arbitrage—account for at least some of the expected returns. In the absence of intervention, rational agents would like to take positions to exploit the excess risk-adjusted returns but are unable to do so because of the limits to arbitrage problems.

Intervention is likely to improve this suboptimal distribution of risk because short-term losses or illiquidity do not constrain the government in the same way that they limit private agents.[12] Governments can make significant long-term bets, easily weathering short-term losses. In addition, governments might find the principal-agent problem easier to manage, given that portfolio value does not affect the compensation of their employees. Indeed, the incentives of public sector employees might lead public agencies to take insufficient risk. Active reserve

[11] Solnik (1974), Stulz (1981), and Adler and Dumas (1983) show that deviations from purchasing power parity can make the level of foreign exchange rates a priced risk.

[12] Alternatively, one might think that principal-agent problems constrain long-term private speculation. That is, owners of capital can monitor their traders/money managers only imperfectly. Owners do not know the true distribution of asset returns and must infer their traders/money managers' performance from short- and medium-term profits. Owners rationally will not ignore near-term losses while waiting for promises of long-term success.

management can effectively exploit expected returns that private agents are unable to fully exploit themselves.

The next section of the paper argues that foreign exchange variability prevents one from measuring the effect of intervention at long horizons. And measuring an increase in utility from the distribution of risk is simply impossible. It is fairly straightforward, however, to measure excess profitability. Because there will likely be unrealized gains and losses over the short- and even the medium-term, I propose that the intervening authority be held accountable for the long-term profitability of their trades. The time horizon for evaluation should be at least 5 years, but not longer than 15 years.

Does intervention work?

Most economists are justifiably skeptical of the idea that intervention has a substantial or permanent effect on exchange rates. The empirical intervention literature goes back at least 20 years, but most of it is not very informative about the efficacy of intervention. Samples tend to be short and unstable, while little attention is usually paid to identifying structural effects. The weight of the evidence suggests that intervention does have a small impact in the hours and days following the transaction. Neely (2005a) reviews the recent evidence on the effectiveness of intervention from such papers as: Chaboud and Humpage (2002), Dominguez (2003a and 2003b), Fatum, and Hutchison (2003), Fischer and Zurlinden (1999), Humpage (1999), Ito (2002), Kearns and Rigobon (2005), Kim (2003), Payne and Vitale (2003) and Neely (2005b). Edison (1993) provides an excellent, comprehensive review of the earlier intervention literature.

The conclusion that intervention has no permanent impact is usually supported by the inability to reject the null of no effect in econometric tests. The impact of intervention at long horizons cannot be measured with any precision, however, because we can say little about

exchange rate behavior at such horizons. The one-year ahead standard deviation of the exchange rate is 16 times the one-day ahead standard deviation.[13] The power of statistical tests declines with the horizon of the effect. And the data contain fewer independent observations for longer horizons—and no information about infinite horizons. In other words, there is too much noise in exchange rate movements at long horizons to reject any hypothesis of interest. But the absence of evidence of efficacy at longer horizons should not be confused with evidence of absence. One simply cannot conclude that intervention has no long-run impact; we just do not know.

It does seem likely that intervention–a change in the government's consolidated balance sheet–has approximately no impact at infinite horizons, though we cannot test this. But accepting the fact that intervention cannot permanently influence the exchange rate does not mean that it cannot speed the return to fundamental values, even if only a little.

The econometric literature evaluating the effectiveness of intervention is very large. Techniques to deal with instability, simultaneous equations bias and identification of structural effects are imperfect, and the inherent noisiness of exchange rates seems almost insoluble. Compellingly, however, the men and women who actually conduct intervention–who have collectively seen many natural experiments–unanimously believe that intervention does influence the exchange rate. Neely (2000) surveyed the intervention desks of major central banks. Every one of 18 responding central banks reported that intervention does influence exchange rates.

The Lucas (1976) critique complicates any attempt to determine generically whether intervention "works" because whether intervention successfully moves the exchange rates surely

[13] If the the standard deviation of the exchange rate change (Δs) over one year is σ, then the one-day ahead standard deviation is $\sqrt{E\left(\Delta s_{t,t+1}^2\right)} = \frac{\sigma}{\sqrt{250}}$, assuming that exchange rate changes are approximately uncorrelated and there are 250 business days in a year.

depends on the intervention rule. Intervention has been employed for various reasons. It has, for example, often been deployed to counter "disordered markets" by leaning against short-term fluctuations. Such intervention has no information content and is unlikely to be profitable.[14] Therefore, it is unlikely to persuade private agents to trade with it. If, however, market participants know that the goal of intervention is to profit the intervening authority—and that the authority has been successful in this—then private agents will be much more likely to trade with intervention and interventions might become much more effective.

It does not really matter, however, whether intervention has had a quantifiably significant impact on exchange rates or even whether the change in the decision rule would increase its effectiveness. Profitable intervention can still improve society's welfare by replacing distortionary taxation or improving the distribution of risk—defined to include limits-to-arbitrage problems—for society.

How does intervention work?

There are three channels through which intervention might influence exchange rates: 1) the portfolio balance channel; 2) the signaling (policy) channel; 3) the coordination channel. For the purposes of this paper, the main difference between these channels is that the portfolio and coordination effects do not restrict intervention to be consistent with monetary policy. Therefore intervention is potentially an independent policy instrument.[15]

Intervention might work through the portfolio balance channel by altering the relative supplies of imperfectly substitutable international assets (Khouri and Porter (1974) and Henderson (1984)). An official purchase of dollar assets, for example, reduces their supply in

[14] Although the leaning-against-the wind aspect of intervention is unlikely to be profitable, it has usually been combined with other features, i.e., targeting long-term fundamentals, that have been profitable for major authorities.
[15] Even if intervention influences exchange rates through the signaling channel, intervention could still reduce the low frequency variability of exchange rates.

international portfolios, which induces investors to require a lower expected return to hold existing supplies. An immediate appreciation of the dollar delivers the lower expected return.

There are at least two significant problems with taking the portfolio balance effect seriously. The first is that the asset quantities traded in a typical intervention are too small to have substantial portfolio effects without an implausibly low degree of substitutability between assets of different countries. The second problem stems from the fact that an intervention doesn't change the consolidated balance sheet of the public and private sectors (Frankel (1979)). If the government buys JPY (selling the USD), it will decrease the supply of JPY assets held by private agents, who will require a lower expected return on JPY assets to willingly hold them. This lower expected return can be effected by a rise in the current price of JPY. However, a fall in the expected return on JPY assets in the private sector portfolio is balanced by a rise in government revenues which reduces the private sector's future tax payments.

A second channel—signaling—suggests that intervention works by signaling private information about future monetary policy (or other policy) to the public. For example, a monetary authority might purchase the domestic currency to signal to the markets that future policy will be tighter than markets believe. If the signal is understood and credible, market participants will revise their expectations and the spot price of the currency will change accordingly. Effective signaling requires that intervention be systematically consistent with future monetary policy and therefore it is not an independent instrument.

The coordination channel suggests that intervention can influence the value of the exchange rate by coordinating the heterogeneous beliefs of traders on the proper direction of the exchange rate. This channel does not require intervention to be consistent with unexpected monetary policy. One might imagine, however, that it requires intervention to be systematically

consistent with fundamentals.

Arguments Against Intervention

Many arguments against intervention are prefaced on two related ideas: There is no good model of exchange rates—we do not know the effect of intervention—and econometric studies cannot prove that intervention has sizeable, lasting effects. Both of these statements are true but neither really argues against the intervention strategy I am proposing.

As discussed previously, the high degree of unexplained variation in exchange rates, especially at long horizons, makes it unsurprising that econometric tests cannot reject the null that intervention has no effect. On the other hand, the power of such tests is likely very poor against plausible alternatives. In other words, it is unlikely that such tests could reject the null that intervention has a sizeable effect over fairly long horizons. Bayesians might say that the data are consistent with either hypothesis. Given that statistical tests cannot inform us on the issue, there is little sense in appealing to their results, especially when such tests pertain to other reserve management strategies.

While we do not have a complete, predictive model of exchange rates, evidence suggests that volatile expectations, bandwagon effects and limits to arbitrage figure prominently in their determination. Intervention designed to focus volatile expectations on reasonable long-run fundamentals might have a salubrious effect on misalignments.

But suppose that exchange rates really are determined in a wholly rational framework. In that case, intervention will have very small or no effect on exchanges but it will still likely make excess profits for the government, as it has in the past. It would still be a beneficial strategy.

An obvious objection to the philosophy of intervening to exploit a reversion to long-term fundamentals is that there is real-time uncertainty over the long-run fundamentals. Is such a

strategy implementable in real time? To investigate this, one could perform an econometric study with expanding samples to measure whether real-time fundamentals differ significantly from those measured using all the data from the past 30 years. A more powerful argument, however, is that that intervening authorities have already proven that they can measure fundamentals in real time because they have consistently intervened profitably since the breakdown of Bretton-Woods.

Another objection is that government intervention is unnecessary because the intervening authority has no informational advantage over rational, well informed private agents, and the views of the intervening authority are unlikely to influence those of private agents (Schwartz (2001)). It might be true that the intervening authority has, at most, a modest informational advantage over rational, well informed private agents. But the authority does have another big advantage: It can afford to take a long view because it is less constrained by liquidity and principal-agent problems than private firms. And the influence of the intervening authority's views on fundamentals surely depends on the objectives and record of the intervening authority. If it were widely known that the intervening authority has intervened to maximize profits and has consistently been successful, then the authority's strategy could assist in resolving a principal-agent problem that restricts long-term speculation.

Of course, if exchange rates are simply a rational endogenous response to real shocks, any reduction in exchange rate volatility could increase instability in other markets. (It is ironic that economists who deny any possibility that intervention influences exchange rates become concerned that it might stabilize them.) This possibility is belied, however, by the lack of any strong connection between exchange rates and fundamentals. We do not observe that exchange rate regimes with lower volatility produce greater instability in consumption or labor markets.

Humpage (2004) likens the foreign exchange market to a drunken sailor staggering down a hill. The sailor's exact path is uncertain, as is the duration of his journey, but eventually the sailor will get to the bottom, with or without intervention. Likewise, exchange rates will eventually return to fundamental values, though we do not know when or how. If the exchange rate is surely linked to fundamentals in the long run, Humpage asks what good intervention does? This criticism, however, ignores the fact that the duration and extent of exchange rate misalignments have real costs and even a marginal reduction in those misalignments can produce big welfare gains. And even if intervention does not reduce misalignments in the slightest, the profits can reduce distortionary taxation.

But what if the intervening authority "gets it wrong?" Could the license to conduct intervention lead the intervening authority to pursue inappropriate policies? What sort of inappropriate policies might the authority engage in?

Clearly, intervention to defend a fixed parity can be a disaster in a world of rapid capital movements, as illustrated by the experiences of the European Monetary System in 1992-93 and Mexico in 1994. And in the Asian crisis of 1997 countries, such as Taiwan and Singapore, that introduced greater exchange rate flexibility suffered less financial market volatility than did states that intervened to counter exchange rate pressures, as did South Korea and Thailand.

But the hazards of defending a fixed parity are not relevant for considering the reserve management strategy proposed here. The strategy advocated here is expressly designed for floating exchange rates that will experience significant variation, with or without intervention. Reserve positions are adjusted to exploit positive expected excess returns that coincide with exchange rates reverting to long-run fundamentals; intervention does not fight long-run fundamentals.

Another potential danger of permitting active reserve management is that monetary authorities might substitute intervention for proper monetary policies. For example, the authorities might conduct sterilized purchases of the domestic currency in the hopes of keeping the currency strong and preventing inflation in imported goods prices rather than raise interest rates to maintain price stability. Such a strategy would be ineffective in the long run (and perhaps in the short run). Critics of intervention could cite some precedents in this respect. The Banco de Mexico was accused of this error after the peso crisis of 1994.

The Banco de Mexico, however, had committed to keep the exchange rate within a target zone as an instrument to bring down inflation. Sterilized intervention was considered a substitute for domestic monetary policy, which was hamstrung by the weakness of the recently privatized banking sector. Mexico's intervention was designed to defend a fixed parity while bringing down very high inflation in the presence of a very fragile financial sector. It did not exploit deviations of floating rates from long-term fundamentals. Such circumstances are not likely to be very relevant to the strategy I am proposing in which an independent intervention agency conducts a publicly announced intervention strategy that is explicitly designed to profit from a return to long-term fundamentals.

Even if intervention is not actually used to substitute for monetary policy, it could generate confusion over monetary policy objectives. For example, a sale of the domestic currency during a period of uncertainty might lead some to question the commitment of the monetary authority to maintain price stability. If the intervention reaction function and its objective are public knowledge, however, there is little chance that private agents will draw the wrong inference. This would be especially true if the reserve management authority differed from the monetary authority.

Another concern comes from the field of political economy. There will inevitably be calls to conduct intervention to benefit groups whose incomes fluctuate with the value of exchange rates. For example, interest groups such as U.S. autoworkers will demand dollar sales to keep the value of the dollar down to a "fair level." Such demands, however, are likely to be basically consistent with the "buy-low, sell-high" rule that I am advocating. Demands for dollar sales will be strongest when the dollar is high relative to fundamentals. Additionally, intervention could have the added benefit of substituting for more permanent explicit protection for particular industries.

Advocates of intervention must admit, however, that intervention could be conducted badly, could be used to delay needed monetary policies, and/or could lose money. Any policy could be conducted badly. Taxes can be raised to immiserating levels; Budget constraints can be ignored until bankruptcy; Police can treat citizens brutally; etc. The mere possibility of abuse is a weak argument against an otherwise sound idea. This is especially true when simple institutional safeguards could significantly reduce the risks associated with intervention.

P. J. O'Rourke once likened giving money to the government to furnishing teenage boys with whisky and car keys. A skeptic might emotively ask if we should trust unelected bureaucrats to play with taxpayers' money as if they were going to a casino? Would it not be better to trust the wisdom of the marketplace?

The proposed strategy does not involve non-market devices like price controls or regulations, it simply recognizes that government portfolio demands should be chosen dynamically, not frozen at an arbitrary level. A refusal to conduct intervention does not free up the market, it simply means that governments hold static portfolios. This is optimal only under fairly restrictive circumstances. G-7 governments hold gold, foreign exchange, short positions in

various bonds, equity in nationalized industries and they provide implicit or explicit loan guarantees for firms and foreign countries.[16] Governments will hold and manage a portfolio of assets. The only question pertains to the rules under which they will do so.

Conclusions

Foreign exchange intervention has fallen out of favor with monetary authorities in recent years. Many central banks have greatly reduced or eliminated their intervention activities, believing them to be ineffective as independent policy instruments. This paper has argued that major governments should actively manage their reserve assets to profit from—and probably reduce—deviations of exchange rates from fundamentals. Such deviations create expectations of long-term, excess foreign exchange returns. History indicates that such intervention could increase the return to the taxpayers' portfolio, while exposing the taxpayer to very low long-term risk. The benefits from such a policy will be modest, but the costs will be almost zero.

Whether these long-term expected returns result from irrationality or rational risk-premia resulting from institutional limits to arbitrage, government intervention to purchase currencies with high expected excess returns will increase social welfare by replacing distortionary taxation and enabling the government to take positions that limits-to-arbitrage prevent rational private agents from fully exploiting. Additionally, to the extent that intervention moves exchange rates toward long-term fundamentals, it can reduce resource misallocation. The recent literature on inflation targeting could provide valuable lessons in drawing up well thought-out reserve management/intervention policies and monitoring the authorities' compliance with them.

[16] The government's loan guarantee can be regarded as a short position in a put option on a bond.

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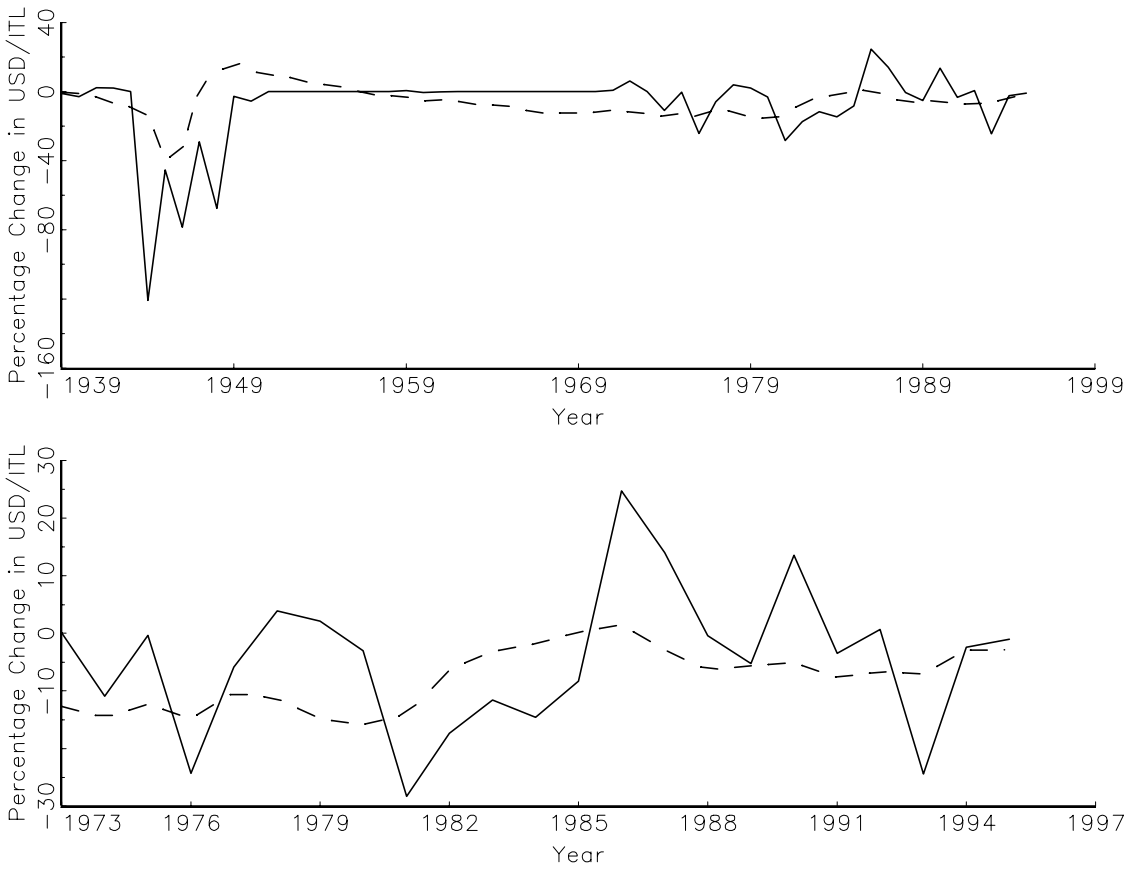
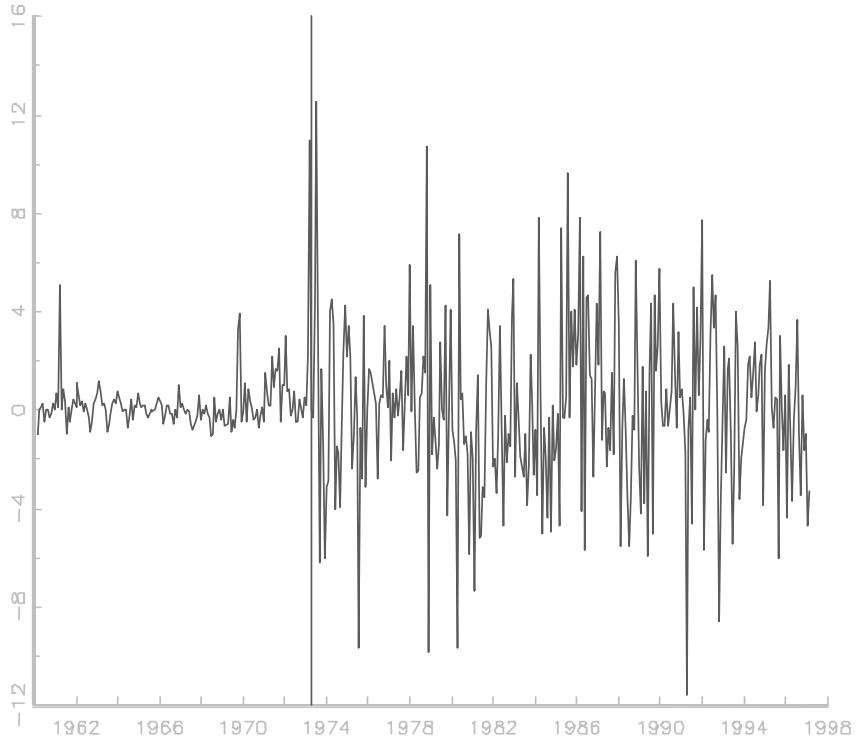
Figure 1: Forecasts of the Change in the ITL/USD Exchange Rate



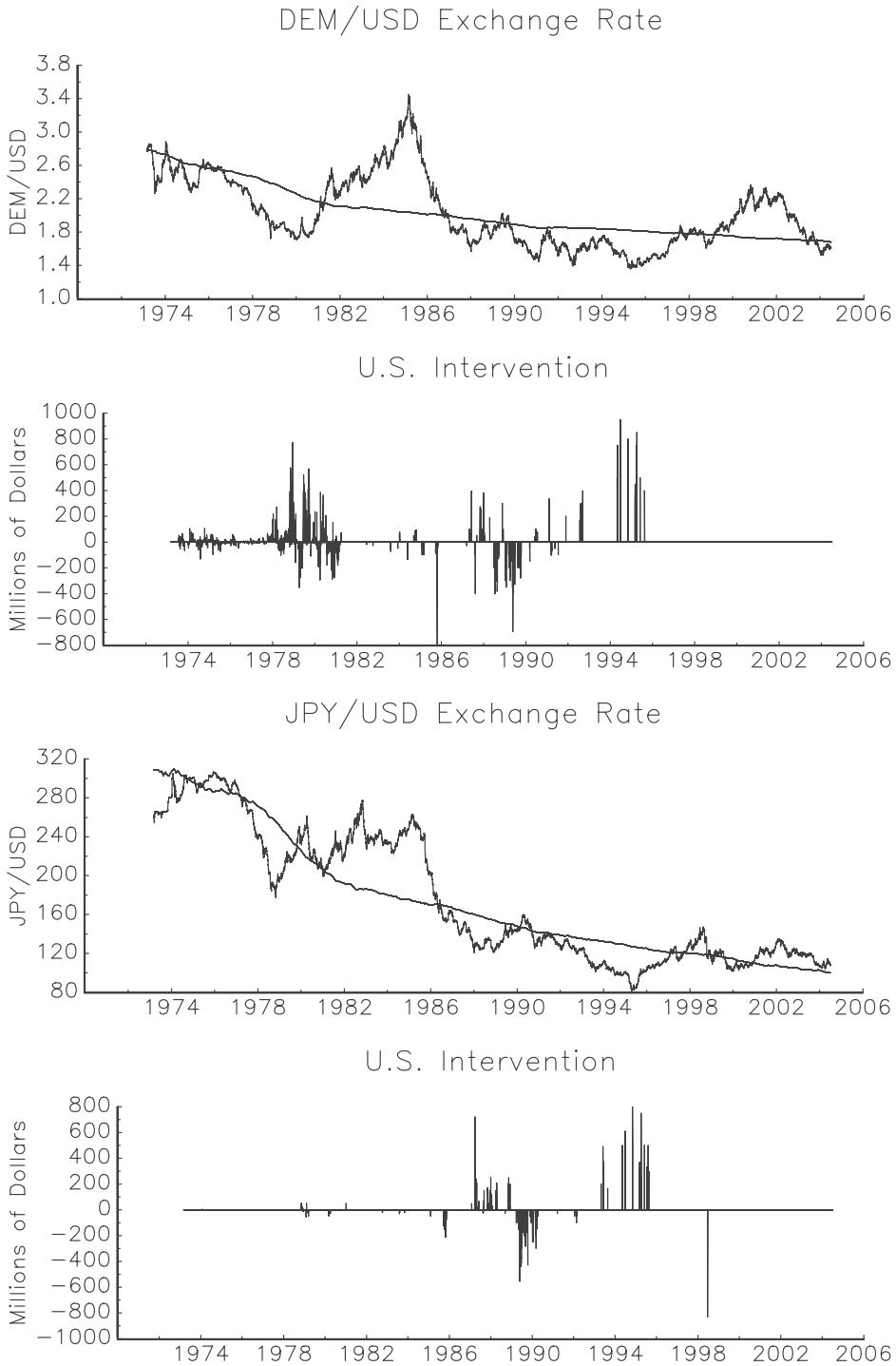
NOTE: The upper panel depicts the percentage annual change in the USD/ITL exchange rate (solid line) and the predicted value from the monetary model (dashed line) from 1939 to 1995. The lower panel depicts the same data over the floating rate period, 1973-1995.

Figure 2: Monthly percentage changes in the DEM/USD real exchange rate.



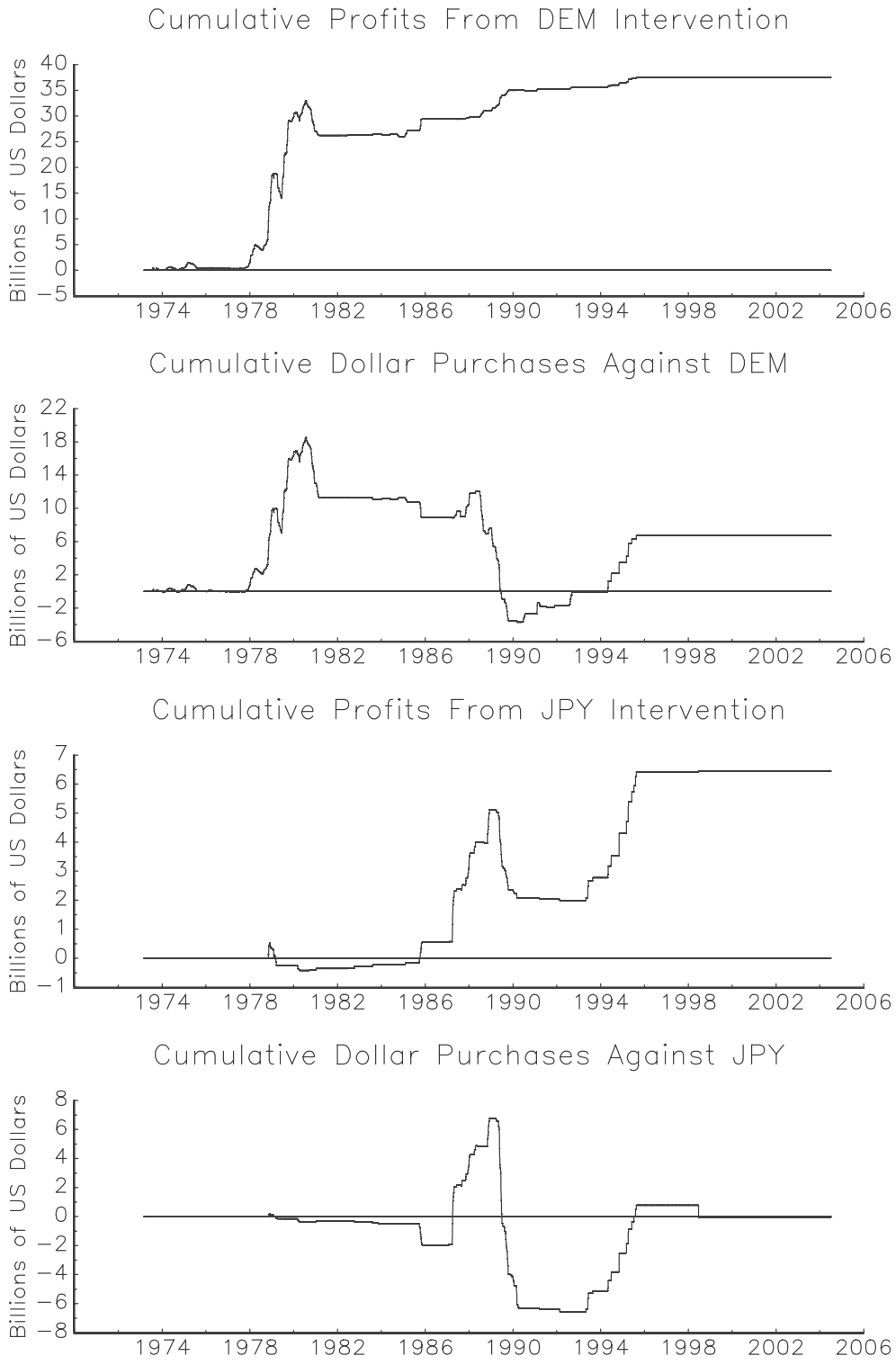
NOTE: The figure depicts monthly percentage changes in the DEM/USD real exchange rate from 1960 to 1998. Real exchange rates became much more volatile after the end of the Bretton-Woods System of fixed exchange rates in March 1973. The vertical line denotes this break date.

Figure 3: Intervention, exchange rates and PPP fundamentals



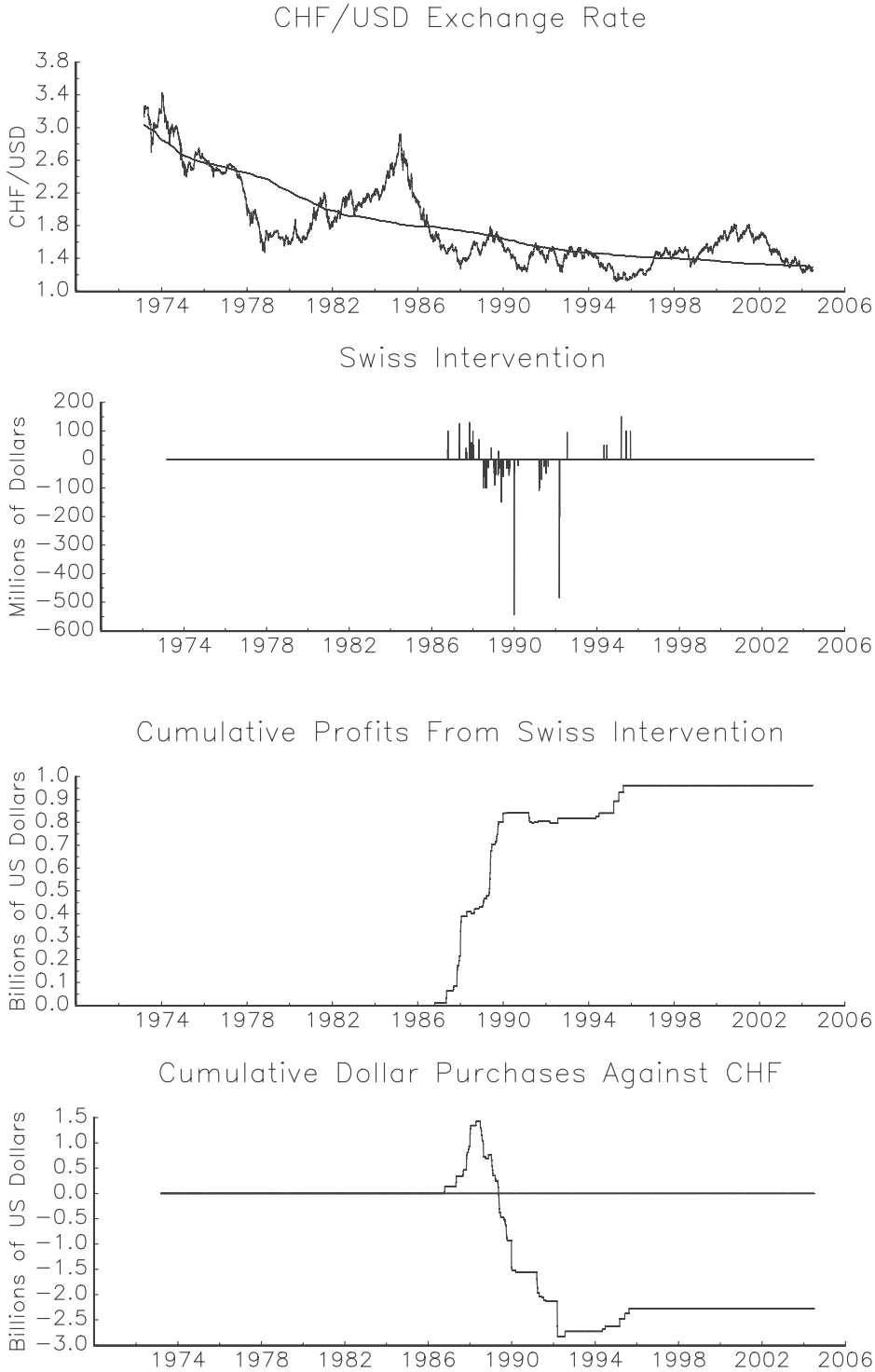
NOTE: The upper (first and third) panels depict the DEM/USD and JPY/USD exchange rates along with a PPP-implied exchange rate. The lower (second and fourth) panels show U.S dollar purchases and sales in those markets from March 2, 1973 to July 1, 2004. DEM/USD rates after the introduction of the euro in 1999 are imputed from EUR/USD rates. U.S. purchases of the euro in September 2000 are not included in the DEM intervention.

Figure 4: Cumulative profits from U.S. intervention



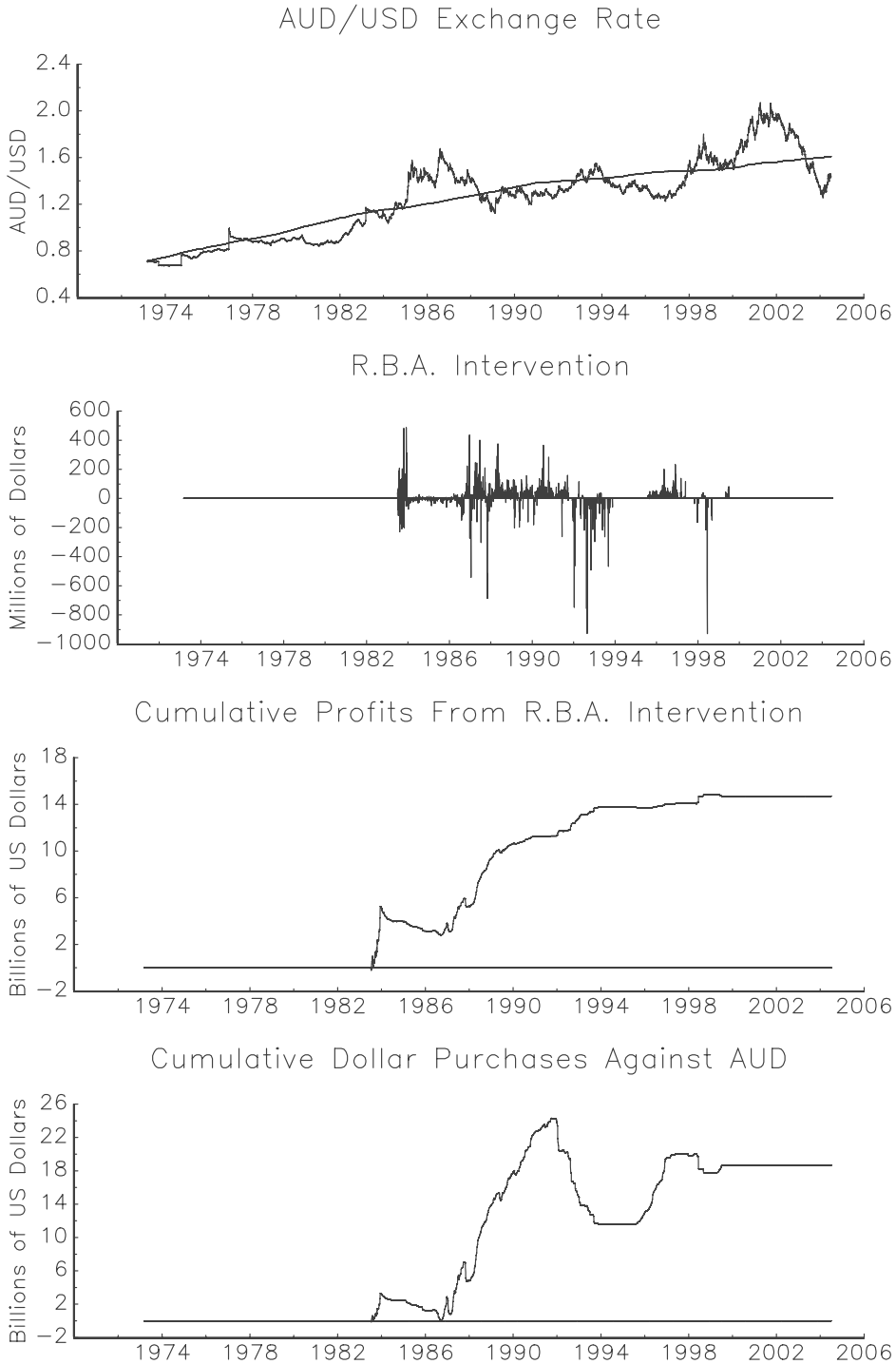
NOTE: The upper panels depicts cumulative U.S. profits and official U.S. purchases in the DEM/USD market from March 2, 1973 to July 1, 2004. The lower panel depicts the same statistics for U.S. intervention in the JPY/USD market. Profits are in excess of borrowing costs.

Figure 5: Cumulative profits from Swiss intervention



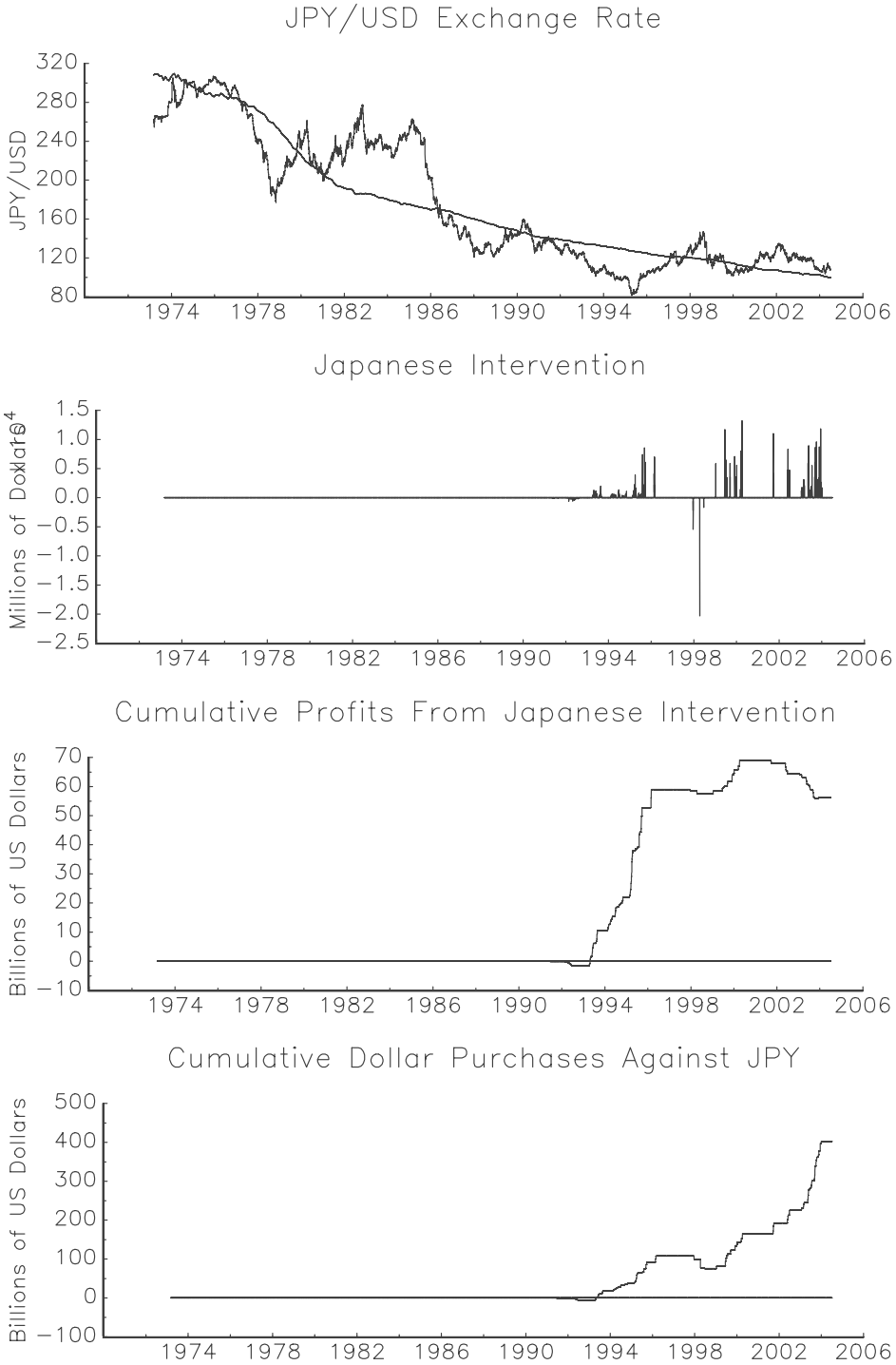
NOTE: The first panel panels depicts the CHF/USD exchange rate along with a PPP-implied exchange rate. The second panel is Swiss purchases of USD from 1986-1995. The third panel is cumulative profits from that intervention while the fourth panel shows cumulative Swiss National Bank purchases of USD in the CHF market.

Figure 6: Cumulative profits from Australian intervention



NOTE: The first panel panels depicts the AUD/USD exchange rate along with a PPP-implied exchange rate. The second panel is RBA purchases of USD from 1983-2000. The third panel is cumulative profits from that intervention while the fourth panel shows cumulative RBA purchases of USD in the AUD market.

Figure 7: Cumulative profits from Japanese intervention



NOTE: The first panel panels depicts the JPY/USD exchange rate along with a PPP-implied exchange rate. The second panel is Japanese purchases of USD from 1991-2004. The third panel is cumulative profits from that intervention while the fourth panel shows cumulative Japanese purchases of USD in the JPY market.